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THE
MIAMI AQUARIUM
AND
BIOLOGICAL LABORATORY
MIAMI, FLORIDA

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Dedicated to the scientific collection and
popular diffusion of knowledge relative to
the marine life of the warm seas. :: ::



OUTLINE MAP SHOWING GENERAL DIRECTION OF THE GULF STREAM AND
OTHER CURRENTS IN THE ATLANTIC. THE STRATEGIC POSITION
OF THE MIAMI AQUARIUM CAN THUS BE REALIZED.

Biological
& Medical
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SCOPE OF THE MIAMI AQUARIUM AND BIOLOGICAL STATION

The Miami Aquarium Association proposes to conduct its station in an independent way, without giving control of its policies or direction to any one school or group, in the belief that such a policy will best serve all. The Aquarium will be glad at all times to receive constructive advice and suggestions for its further development and service. Tables in the laboratory will be available to recognized universities, colleges, and schools, and to individual investigators whose applications are approved. The annual fee is \$500. Visitation and correspondence are cordially invited, and full information as to details will be forthcoming upon request by addressing "The Director, Miami Aquarium, Miami Beach, Florida."

IN NO other branch of human inquiry are richer results in store for the patient interrogator of Nature than in the study of the problems of the life of the sea.

It has been said that the seashore is the greatest arena of organic evolution to be found in the world. It was here that living things first came out of the water and found a habitat on land. It is here that we can still best trace the steps by which the transformation of marine life into land life was accomplished.

It is realized at biological stations such as Woods Hole, Mass.; Plymouth, England; Naples, Italy, and elsewhere that a well-equipped and scientifically maintained aquarium connected with a biological station reveals a new world of never-failing interest, economic profit, and never-ending opportunity for inquiry.

But nowhere else is the seashore so prolific of lessons for those who are painstaking in their studies as in tropical waters. Here marine species reach their maximum of development, whether measured by their number, their variations, or their bizarre characteristics.

The Miami Aquarium, situated at Miami Beach, Miami, Florida, is most admirably located for studying the fish resources of tropical waters. It is far enough north to be in touch with many of the species which visit Middle Atlantic seaboard waters; it is far enough south to tap the tropical and subtropical research material, and close enough to the axis of the Gulf Stream to command the pelagic life swept out of the Gulf of Mexico and equatorial waters by that ocean current.

Biscayne Bay abounds in ever-changing marine life, the adjacent keys offer all-the-year-round opportunities for collecting material for study, and the delightful and uniformly salubrious climate makes research continuously possible.

The laboratory of the station, fronting upon the beautiful bay itself, has been equipped to accommodate eighteen investigators at a time. It is up to date in every respect, possessing the best microscopes and photographic apparatus obtainable, various reagents, screens for tables, electric lights, and all other necessary equipment for biological research. It has a commodious dark room, motion-picture camera and projectors, and an abundant supply of running sea-water for the individual aquaria.

Some one has called science human experience tested and set in order, and in no branch of human inquiry is there more room for "testing and setting in order" than in biology.

The Miami Aquarium library is being rapidly built up and includes valuable volumes gathered from every country where marine research is followed. The fundamental reference works are already in hand and important additions are being received every month. It is the purpose of the management of the Biological Laboratory to make the collection in its library as complete and as helpful as possible to those who come to do original research.

Research material is, of course, the prime requisite of a biological station, and especial attention is given to such supply here. The laboratory has provided numerous aquaria supplied with

constantly changing sea-water in which this material may be kept. It also owns several power boats and a collection cruiser provided with wells for transporting marine animals alive to the Aquarium. With these facilities each investigator can be assured of an adequate supply at all times.

The laboratories will be open throughout the year, and while at present there are tables for but eighteen workers at a time, the institution has planned to expand its facilities as the demand for them grows, by the building of a second wing for increased laboratory space, which likewise will be made available to investigators, believing that there is no way in which mankind can be better served than by the extension of scientific investigation into the wonderful resources of the warm seas.

OFFICERS OF THE ASSOCIATION

James Asbury Allison, President.
 Carl Graham Fisher, Vice-President.
 John Oliver La Gorce, Secretary-Treasurer.
 Louis L. Mowbray, Director.

ADVISORY COMMITTEE

Dr. Alexander Graham Bell; Gilbert Grosvenor, President of the National Geographic Society; Dr. Barton W. Evermann, President of the California Museum of Science; Dr. Henry Fairfield Osborn, President of the New York Zoölogical Society; Dr. Hugh M. Smith, U. S. Commissioner of Fisheries; Thomas R. Shipp; David Fairchild, agricultural explorer; Dr. Charles H. Townsend, Director of the New York Aquarium; Dr. Charles D. Walcott, Secretary of the Smithsonian Institution; Dr. Carl H. Eigenmann, of the Indiana University; Dr. E. Lester Jones, Director, Coast and Geodetic Survey.



THE CITY OF MIAMI AS SEEN FROM THE AQUARIUM ACROSS BISCAYNE BAY AT SUNSET

Miami is the fourth largest city in Florida. Its permanent population is thirty thousand, and the remarkable growth and prosperity of this the county-seat of Dade County, from which comes one-third of all the grape-fruit in the United States, is due to the progressive ideas, enterprise, and business vision of its citizens. Connecting Miami with Miami Beach, across the bay, a distance of two and one-half miles, the county has just completed a million-dollar causeway of concrete and steel sixty feet wide. The Aquarium is at the terminus of this wonderful causeway on the ocean side.

TREASURE-HOUSE OF THE GULF STREAM

The Completion and Opening of the New Aquarium and Biological Laboratory at Miami, Florida

BY JOHN OLIVER LA GORCE

AUTHOR OF "DEVIL-FISHING IN THE GULF STREAM," "A BATTLE-GROUND OF NATURE: THE ATLANTIC SEABOARD,"
"PENNSYLVANIA, THE INDUSTRIAL TITAN OF AMERICA," ETC.

NO LONGER can the land animal kingdom of the earth and its peculiar relation to mankind be called a mystery, for painstaking scientists and intrepid hunter-explorers through the centuries have penetrated to the remote places of the world and brought back to civilization minute accounts of the habits and characteristics, the skeletons and skins, as well as living specimens of wild animal life. As a result, we find that today only at rare intervals is a new and distinct species of quadruped or biped made known to us.

Our knowledge of the denizens of the deep is another story. In this department of zoological research, however, though the recognized species have increased from fewer than 300 to more than 12,000 within less than two centuries, there are numerous varieties yet to be recorded, many more to be studied, and large areas rich in marine fauna still to be explored scientifically for the common good of mankind.

Since the dawn of human history, man has studied land animal and bird life—in fact, he now knows much of prehistoric creatures long since extinct.* But the "waters under the earth" still hold countless fascinating secrets which challenge the ichthyologist, who pursues a branch of science pertaining to the study of fish life only a few hundred years old, with a world of sub-sea life to conquer, especially among the warm waters of the semi-tropic regions.

THE PART THE POOR FISH WILL PLAY IN A
WORLD PEACE

This challenge now has a mighty urge, in that a mounting population faces a dwindling pro rata food supply, and must

turn to the sea, as its primitive ancestors once did for an entirely different reason, if it would assuage its hunger and avert the national "land hunger" which is a potent stimulus to war. In the light of a better realization of the economic causes of wars, it is not stretching the imagination to say that he who discovers a new food-fish supply is an apostle of future peace.

Once more, as in its other natural resources, the United States of America is favored among nations. Paralleling our eastern coast for hundreds of miles, the Gulf Stream, that mightiest river of the ocean, which sweeps northeastward with such giant force to turn back the icy waters of the Arctic from our shores, performs another and less widely recognized service in depositing upon America's southeastern threshold a gift of fishes which some day may be regarded as providential, if not miraculous. Indeed the map-minded person might even picture a peninsular hand, in the shape of Florida, reaching out to receive this boon, nourished in the warm waters of the kindly current.

The Gulf Stream is, in truth, a happy hunting ground for scientist, amateur angler, and professional fisherman. In its waters there have been found some six hundred varieties of fishes, composing practically one-fifth of the entire fauna of the American continent north of Panama.

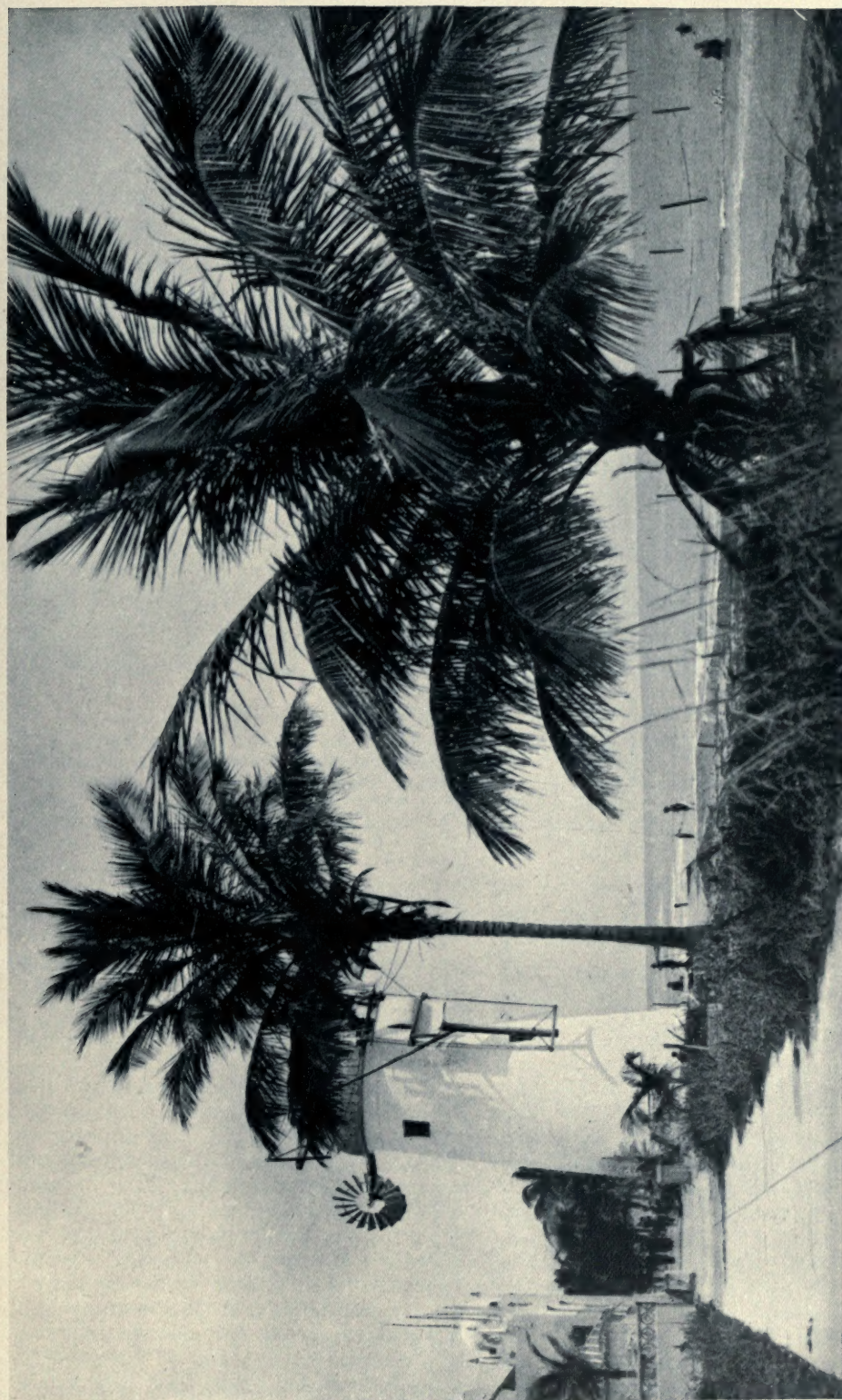
The most southerly city on the Florida mainland is Miami, nestling beside the limpid waters of Biscayne Bay, separated from the ocean by a peninsula which completely protects the city from the lashing of an angry ocean during seasonal storms. At Miami Beach has been constructed an aquarium and biological laboratory (latitude 25 degrees 46 minutes north and longitude 80 degrees 7 min-

* See "Hunting Big Game of Other Days," by Barnum Brown, in the May, 1919, NATIONAL GEOGRAPHIC MAGAZINE.



THE AQUARIUM BUILDINGS FROM BISCAYNE BAY : MIAMI BEACH, FLORIDA

The Biological Laboratory is located in the right wing of the building. The Aquarium grounds and gardens are being rapidly developed, and already contain numerous varieties of beautiful palms and sub-tropical flora. One of the Aquarium collecting boats is moored to the dock.



Photograph from Walter A. RuKeyser

THE WINDMILL AND CASINO, MIAMI BEACH, FLORIDA

The waters of the Gulf Stream itself lave the shores of Miami Beach and afford delightful bathing the year round. The Aquarium and Biological Laboratory is situated near by.



ONE OF THE EXHIBITION CORRIDORS: MIAMI AQUARIUM

The interior of the Aquarium building is especially designed for the best arrangement and grouping of the fifty large tanks in which the hundreds of unusual and gorgeously colored fish can be seen and studied by the visitors. During the day the only illumination within the corridors is the sunlight, which enters from skylights directly above each tank, and the light thus diffused through the sea water within the tanks creates a very realistic atmosphere of the ocean's depths.

utes west), which, because of its ideal location and equipment, will take rank with the great aquariums of the world.

HUMAN INTEREST IN THE QUICK

Humankind takes a deep interest in animate things, and fish seem to have a peculiar and potent appeal to man. The child turns from toy and pet to gaze upon goldfish in a tiny bowl; the adult will sit by stream or in a boat by the hour in the hope of landing a "string." Angling, in fact, makes the whole world related. It is one of the few sports that knows no flag nor race.

A striking proof of this interest is manifested in the fact that each year the visitors to the New York aquarium, located on the tip of Manhattan Island, are twice as many as those who go to the more conspicuous and accessible Metropolitan Museum of Art on upper Fifth Avenue.

May the reason of this fascination not be the racial memory of that far-gone time when our remote ancestors, still too primitive to invent weapons to give them sure advantage in hunting wild animals, turned to stream and ocean inlet for a palatable, abundant, and ever-ready food supply?

The wonder is that science, which has been defined as "intelligent curiosity," should have waited so long to turn to that field which offers a vast, unexplored content of animal creation. That Protean observer, Aristotle, studied fish life, but from his day nearly twenty centuries intervened before the Swedish savant, Peter Artedi, "Father of Ichthyology," met an untimely death by drowning in a Holland canal, but left enough notes of his observations to enable Linnæus to publish them (in 1738), and thus establish a starting point for modern study of genus and species.



AN OCTOPUS IN ONE OF THE MIAMI AQUARIUM TANKS

The octopus is a source of fascination to most people in spite of its repulsive appearance. It has a large, ugly head, a fierce-looking mouth armed with a pair of powerful, horny jaws shaped much like the beak of a parrot, and topped with two diabolical eyes set close together that can send forth a demoniac glare when angry. The grotesque head is mounted on a somewhat oval body from which radiate eight arms usually united at the base by a membrane. The arms, or tentacles, are provided with rows of suckers with which to clasp and cling to its prey with uncanny strength and quickness. The octopus has the faculty of instantly changing color before the very eyes, and is constantly doing strange and weird things, which always attract the attention of the passer-by.

Twice fish figured importantly in our national life. The inland stranger who visits Boston may smile at the "sacred codfish," which is so conspicuous in the decoration of the State House; but a study of the Bay State's early history will impress every American with the major part fishing played in the industrial history of his country. Moreover, the prominence of fish food in the conservation program that helped toward a glorious victory in the World War is a matter of recent memory.

THE ECONOMIC SIDE OF THE STUDY OF MARINE FAUNA

Now there is not only the food problem urge to impel scientific study of fish, but many other fish products, such as cod-liver oil, menhaden oil as a linseed-

oil substitute in paint manufacture, seal oil for miners' lamps, and the possibilities of fish guano as fertilizer, fish meal as cattle food, shark skin for leather, and fish oil for glue, to warrant a closer scrutiny of the industrial uses of fish.

Popular interest and industrial possibilities are two reasons why humanized geography is such a compelling subject. The Miami Station not only will afford visitors an opportunity of getting a bird's-eye view of the little-known life forms of ocean depths, but it will offer unique opportunity for scientific observation and study of these sub-sea citizens.

It is difficult to transplant and keep alive the denizens of the warm seas, for they do not take kindly to the colder waters of the north; therefore, to exhibit them successfully, not only must clear



Undersea Photograph by Dr. W. H. Longley

UNDERSEA STUDY OF A FAMILY GROUP OF YELLOW GRUNTS

To realize the full value of this amazing photograph, one must remember that these multihued fish are at home among the coral and sea-fans of their natural habitat, many feet beneath the surface of the Gulf Stream. The yellow grunt is one of the species of fishes which makes a croaking or grunting sound, a fact from which it derives its name. A distinguishing feature of this fish is its bright red or orange color at the base of the jaws and inside the mouth. The color patch is revealed to its fullest extent when the mouth is opened wide in the presence of an enemy, or when it invites the services of the butterfly fish to enter between its jaws and extract certain parasites attached to the walls of its mouth (see Color Plate VII).

and uncontaminated salt water itself be transported from miles out in the ocean to the tanks of the city aquariums in the north, but the water must be kept heated the year round to the proper temperature of their southern habitat.

More fortunate is the Miami Aquarium, which is located within a few hundred yards of the outlet of Biscayne Bay into the old Atlantic; for it has salt water from the Gulf Stream itself available for changing in the tanks at every turn of tide, if necessary, and there is no necessity for artificial heating all year around, as the water is never below 63° F. in winter nor above 85° F. in summer.

THE MIAMI AQUARIUM HAS EXCEPTIONAL EQUIPMENT

The Miami Aquarium is equipped with fifty exhibition tanks, each with a visible area of 4 x 6 feet. One of the glass-front tanks is 36 feet long, 15 feet in width, and 10 feet deep—probably the largest display tank in the world. In it may be shown fish up to 12 feet in length. The exhibition tanks are arranged along corridors, in the general form of a Maltese cross, with a central rotunda.

The only light is that admitted from skylight openings directly over each exhibition chamber, so that the sun's rays filtering through the waters of the tanks give the interior of the aquarium the atmosphere of the ocean bottom itself, and the multihued and wonderfully beautiful fish citizens of the tropics stand out in their regal colors and without the optical distortion which arises from artificial illumination against glass. To further create the atmosphere of the natural habitat of these fish, the tanks are lined with coral rock and festooned with living specimens of the wondrous flora of the ocean bed.

This plant life also is needful to make the captured specimens feel at home in their new environment, and, with such peaceful and customary surroundings, most of them soon become domesticated and seemingly unaffected by their transplanting. Indeed, they are relieved of the burden of the high cost of living and are even willing to give up their pursuit of prey, since their natural food is supplied at regular intervals.

Most people who live far from the subtropic seas, especially those in inland America, have little conception of the wondrous beauty of the colored fish of our southern waters.

FISH TINTS THAT CHALLENGE THE RAINBOW

Elsewhere in this number will be found a series of four-color reproductions of life portraits of some of the more common of these richly colored specimens. These studies (see Plates I to VIII, pages 61 to 68) were made by a noted artist, who watched the fish within the tanks of the aquarium day in and day out, studied their color phases, and the ability of many of them to change their tints and hues, as does the chameleon, until he was able to transfer a suggestion of their rainbow coloring to the canvas.

To the student of ichthyology, the completion and opening of the Miami Aquarium early in January, 1921, will be an occasion of moment, for this station is the only one of any size on the entire South Atlantic seaboard, and is located but twelve miles from the axis of the Gulf Stream.* The Biological Laboratory, equipped with tables for individual or class use, offers opportunity for the scientist and student to pursue these engrossing studies with every convenience of supply and equipment and with their study subjects ever available under most favorable conditions. The institution will specialize in the investigation of the migration of food-fish and the artificial cultivation of the spiny lobsters, stone crabs, et cetera.

Instead of having to go to the great Italian station at Naples, or the Museum of Oceanography at Monaco, students of fish life will be offered the facilities outlined, in their own country, for our own subtropic waters have all that the Mediterranean affords and much besides.

THE PERSONNEL OF THE AQUARIUM

The director of the Miami Aquarium, Mr. L. L. Mowbray, has acquired an extensive knowledge of warm-sea fish in studies extending over many years. He

*See "The Grandest and Most Mighty Terrestrial Phenomenon: The Gulf Stream," by Rear Admiral John E. Pillsbury, in the NATIONAL GEOGRAPHIC MAGAZINE for August, 1912.

built and had charge of the aquarium at Bermuda and, after developing that to its full possibilities, was associated later with the work of the Boston and New York aquariums.

Mr. Mowbray has had charge of the installation of the complicated tanks and interior equipment of the Miami Aquarium and, with his assistants, already has obtained from every available nook and hiding place among the Florida Keys and the Bahamas more than 2,500 fish specimens for exhibition purposes. These range from the lordly tarpon to the gentle angel-fish. In the aquarium grounds are open tanks in which are sea-cows, otters, and alligators.

FOOD VALUE OF WARM-WATER FISHES TO BE ESPECIALLY STUDIED

The president of the Miami Aquarium Association is Mr. James Asbury Allison, whose great interest in sport fishing brought about a desire to make available a laboratory where investigations might be carried on concerning the food value of warm-sea fish, and thus enlarge the food supply of the country.

One of Mr. Allison's desires is to develop practical data concerning the food worth of certain fishes at different periods of the year. For example, it will be valuable to housewives to know that a mullet at six cents a pound may be, during certain months, because of what it eats during that time, as valuable in food content as the halibut or sea bass, which cost four times as much, and can be prepared for the table in an equally appetizing manner. Not only will the aquarium seek information of this character through scientific study, but, having ascertained the facts, it will place them at the disposal of the public in popular, understandable form.

FIRST OF THE AQUARIUM EXPEDITIONS FINDS A FLAMINGO COLONY

Already the Miami Aquarium has achieved a success in sending an expedition to Andros, the largest, but least known, of the Bahama Islands, to relocate the most beautiful of the larger birds of the world, the glorious flamingo, once indigenous to Florida, but which no longer exists on the American continent—indeed, it is making its last stand

in the New World on this island in the Bahama group.

The party of naturalists, ornithologists, and artists, after weeks of effort in the tidal swamps and uncharted bayous, finally located the flamingo colony and collected valuable data.

Upon the return of the expedition to Nassau, permission was given by the colonial government to bring back to Miami a sufficient number of the birds for propagation purposes, and they will be located in a giant aviary on the beautiful shores of Flamingo Bay, only three miles from the aquarium buildings. It is hoped that in this natural habitat the birds will reacclimate themselves and multiply in large numbers, so that they may once more take their place in the natural history of the United States.

A method by which the aquarium intends to popularize the study of fish life will be by making motion pictures of the peculiar habits of fish, of their movements in the water, and their ability to take on a protective coloration when frightened or otherwise disturbed. Motion pictures also will portray the hatching of eggs, the development of the spawn by its natural instincts, showing its efforts toward self-preservation and desire to escape the fate that constant warfare in the seas portends.

EMINENT AUTHORITIES ON NATURAL-HISTORY SUBJECTS AMONG ADVISERS

Carl G. Fisher is Vice-President of the Association, John Oliver La Gorce, Secretary and Treasurer.

The advisory committee is composed of Alexander Graham Bell; Gilbert Grosvenor, President of the National Geographic Society; Dr. Barton W. Evermann, President of the California Museum of Science; Henry Fairfield Osborn, President of the New York Zoological Society; Dr. Hugh M. Smith, U. S. Commissioner of Fisheries; Thomas R. Shipp; Dr. David Fairchild, agricultural explorer; Dr. Charles H. Townsend, Director of New York Aquarium; Dr. Charles D. Walcott, Secretary of the Smithsonian Institution; Dr. Carl H. Eigenmann, of the Indiana University; Dr. E. Lester Jones, Director, Coast and Geodetic Survey, and other well-known naturalists.



THE SQUIRREL FISH OR SOLDATO (*Holocentrus ascensionis*)

These bright hued habitants of the tropical seas are to be found in the waters surrounding the Bermudas, Florida, the West Indies, St. Helena and Ascension Island. They reach a length of two feet, and are considered a good food fish.



THE PORK FISH (*Anisotremus virginicus*)

This important food fish, found from Florida to Brazil, reaches a length of fifteen inches, and lives in large numbers about coral heads and reefs. It is easily trapped by market fishermen.



FOUR RESPLENDENT TYPES OF ANGEL-FISH

The Blue Angel-Fish (*Angelichthys isabelita*), shown at the lower left, feeds chiefly on crustaceans, and lives among the coral reefs of the Florida Keys and the Bermudas. The Black Angel-Fish (*Pomacanthus arcuatus*), shown at the upper right, is found from New Jersey, through the waters of the West Indies and as far south as Bahia, Brazil. It is one of the most beautiful of reef dwellers. The French Angel-Fish (*Pomacanthus paru*), shown at the lower right, is found from Florida to Bahia, and reaches a foot or more in length, but is not considered a good food fish. The Rock Beauty (*Holacanthus tricolor*), upper figure, is rarely found in Florida waters, but swims as far south as Bahia. It lives in the deeper parts of coral reefs, and is most difficult to trap.



THE SPADE FISH IS ALSO KNOWN AS THE WHITE ANGEL (*Chaetodipterus faber*)

This excellent food fish, which attains a length of from two to three feet, is caught by hook from Cape Cod to Rio de Janeiro. It is especially abundant on our South Atlantic Coast.



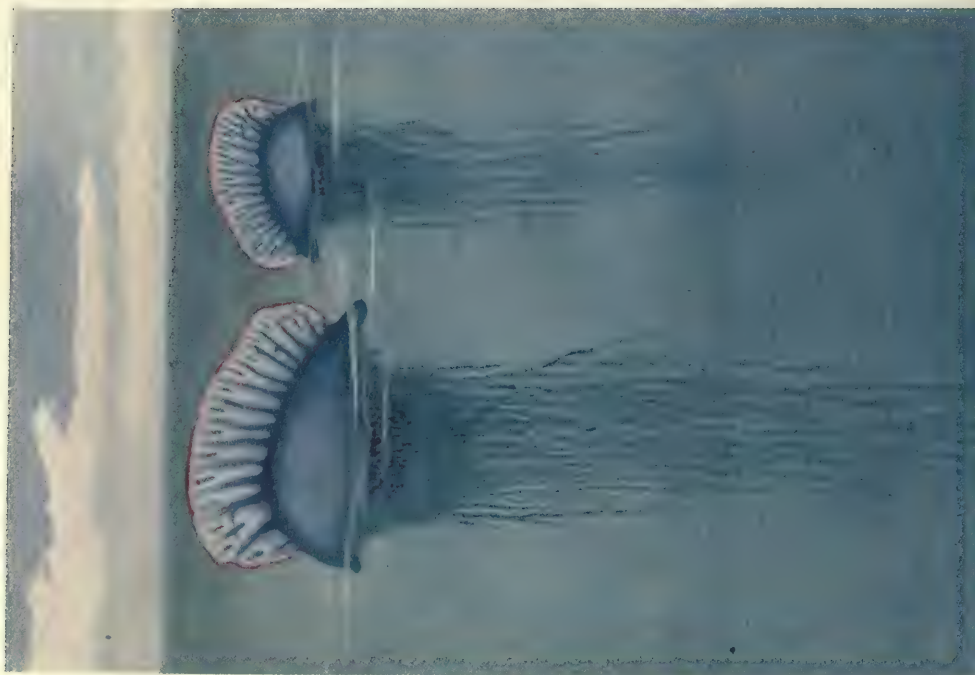
THE FOUR-EYED FISH (*Chaetodon capistratus*) AND BUTTERFLY FISH (*Chaetodon ocellatus*)

The Four-Eyed Fish, shown in the left top corner, is a parasite hunter. It even goes into the mouths of larger fishes which remain perfectly still while the little fellow hunts for its prey. The Butterfly Fish is one of the most conspicuous of reef dwellers. Both species are found in Florida and West Indian waters.



THE GREEN MORAY (*Lycodontis funebris*)

This largest of eels; which sometimes reaches a length of eleven feet, is an excellent food fish. It is found in tropical seas from Bermuda and the Florida Keys to Rio de Janeiro, and from the Gulf of California to Panama and the East Indies.



THE PORTUGUESE MAN-OF-WAR (*Physalia physalis*)

Floating on the surface with the tide and currents, in search of food, this curious sea creature trails its tentacles behind it for forty feet. The tiny fishes upon which it preys become helpless after coming in contact with the stinging cells of the tentacles. The Portuguese Man-of-war is found in tropical seas, but sometimes strays as far north as Cape Cod. Among the tentacles of this creature the little Portuguese Man-of-war Fish hides from its enemies.



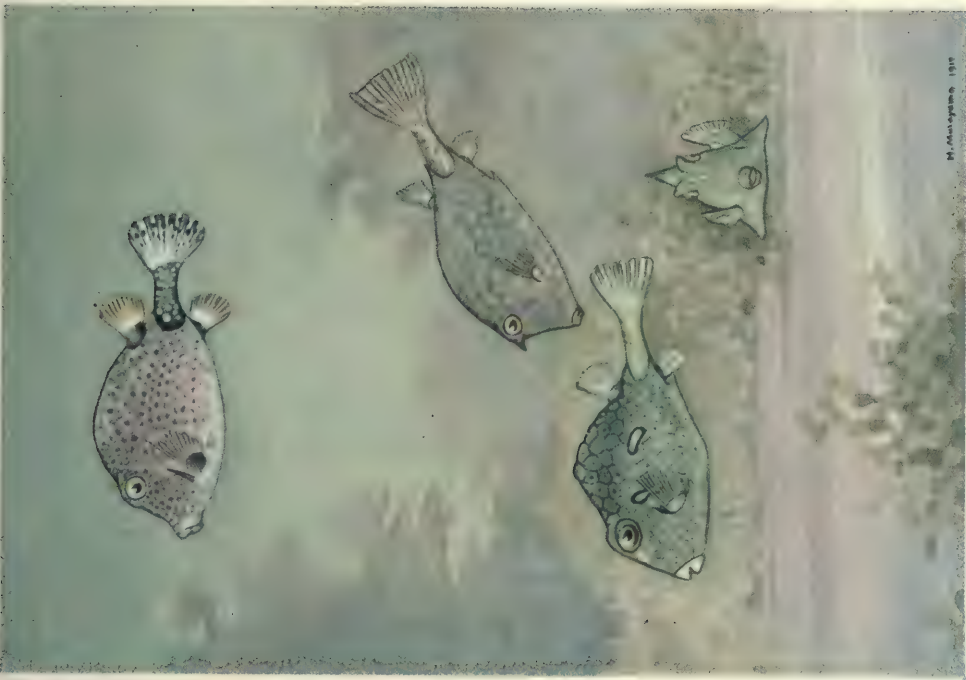
THE SEA HORSE (*Hippocampus*)

This is the only fish which possesses a prehensile tail. With its curious appendage, it holds to seaweed while feeding on small crustaceans. The female deposits her eggs in an external abdominal pouch of the male, where they are hatched. The Sea Horse is found in all warm seas, including the Caribbean, the Black Sea, and the waters south of Japan. One species is found from South Carolina to Cape Cod.



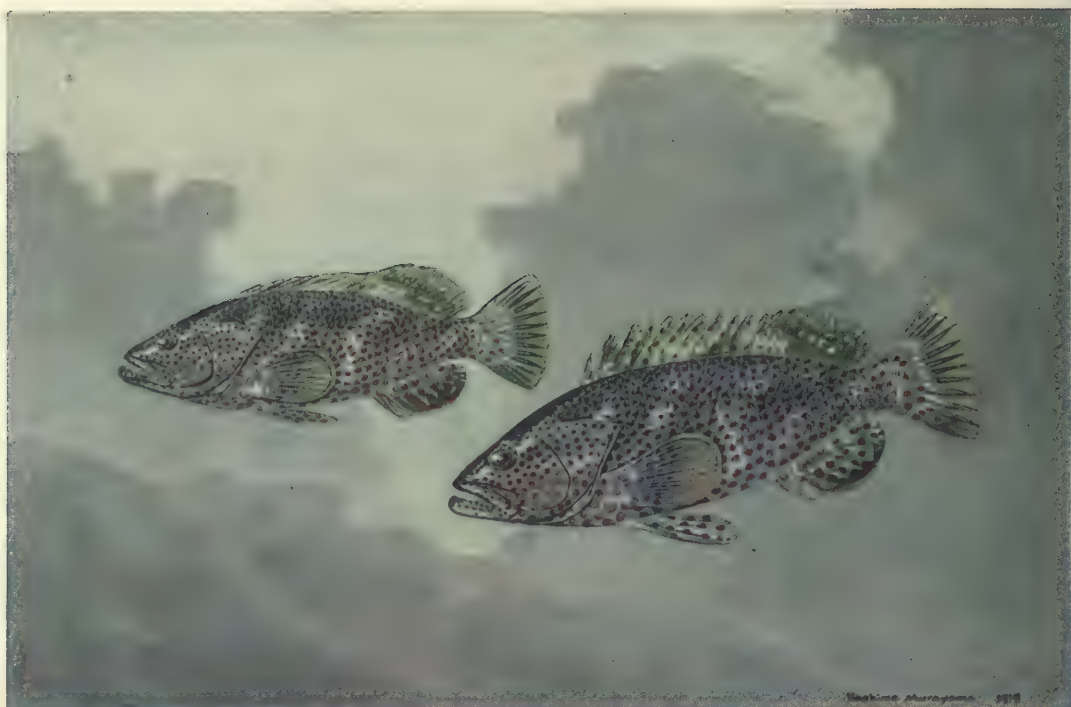
THE QUEEN TRIGGER-FISH (*Balistes vetulus*)

Found in Florida, Bermuda, West Indian and Bahama waters, and in the Indian Ocean, the Queen Trigger-fish lives on rocky and grassy bottoms. It has a variety of nicknames, such as "Oldwife," "Oldwench," and "Cochina." It takes the hook readily and is esteemed as seafood. This fish gets its name from the fact that the first dorsal fin is composed of a short, stout, rough spine, with a smaller one behind it and usually a third so placed that by touching it the first spine may be set or released.



THREE FREAKS OF FISHDOM

Cuckold (*Lactophrys triqueter*), top figure, is a splendid food fish, living in West Indian waters. The Buffalo Trunkfish (*Lactophrys trigonus*), lower left, is a food fish, reaching a foot in length. The Cowfish (*Lactophrys tricornis*), center, reaches a length of two feet. A face view of the Buffalo Trunkfish is shown in the lower right corner. Each of these fishes has its body enclosed in a hard shell, the fins, eyes and mouth alone being movable. They are often baked in the shell for food.



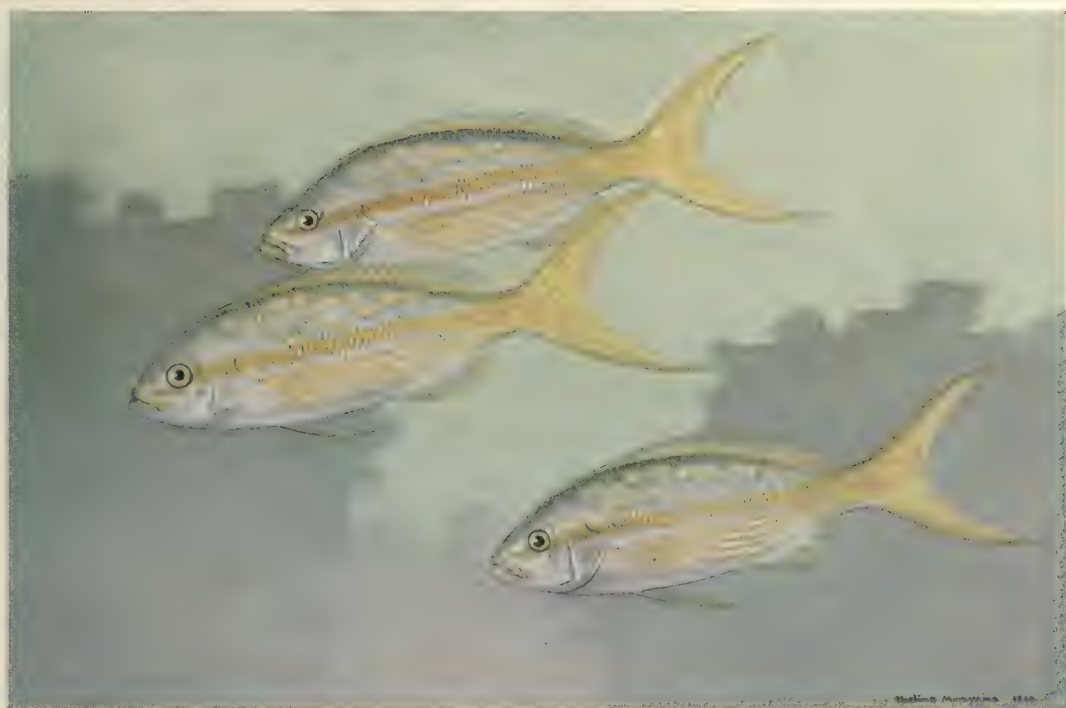
THE ROCK HIND (*Epinephelus adscensionis*)

This spotted beauty inhabits tropical American waters from Bermuda to Brazil, and is often encountered on the east coast of Florida. It lives in rocky places, and is highly esteemed as a food fish, reaching two feet in length.



THE SHARK SUCKER (*Echeneis naucrates*)

This curious inhabitant of warm seas attaches itself by means of a suction disk to sharks, turtles, and other large denizens of the deep. On the African coast it is used by natives to capture turtles. The fisherman attaches a cord to the shark sucker's tail, and allows it to swim among the turtles. When it has attached itself to one, the turtle is quickly hauled in.



THE YELLOW TAIL (*Ocyurus chrysurus*)

This excellent food fish, reaching a length of three feet, is one of the gamiest of the snapper tribe. It is found in the waters off the coast of Bermuda, Florida, and the West Indies, as far south as Brazil.



THE BLUE STRIPED GRUNT (*Heamulon sciurus*)

This food fish reaches a foot in length and lives about rocky shores from the Bermudas as far south as Brazil. It feeds on worms and crustaceans.



THE SERGEANT MAJOR OR COW PILOT (*Abudefduf saxatilis*)

As its name, *saxatilis*, implies, this inhabitant of tropical American waters lives among the rocks. It attains a length of six inches and is not used for food.



THE RAINBOW PARROT-FISH (*Pseudoscarus guacamaia*)

Weighing as much as sixty pounds, the Rainbow Parrot-fish is the largest of its family. The flesh is soft but of very good flavor. It is found from the Florida Keys to Rio de Janeiro, and lives on mollusks, worms, and several species of algae.

INTERESTING CITIZENS OF THE GULF STREAM

BY DR. JOHN T. NICHOLS, CURATOR OF RECENT FISHES

WE THINK of tropical seas as the home of a gaudily colored assemblage of fishes. In a sense, this first impression is correct. Active, short-bodied, elastic-scaled, spiny-finned, bright-colored species here occupy the center of the stage.

As a matter of fact, tropical shorelines are the great metropolis of the world's fish life. The evil-visaged snake-like Moray (Plate III), one of the most degenerate of true fishes, threads the hidden passages among the coral over which Blue Angel (Plate II) and red, green, or parti-colored Parrot-fish (Plate VIII) are swimming.

Out on the open sand, spotted flounders lie, matching their background so as to be well nigh invisible, or little gray gobies move about like shadows, eager to escape detection.

Countless varieties of fishes are hiding in every patch of weed. Schools of silversides, anchovies, and herring dart through the stretches of open water.

It is their function, in the scheme of things, to feed on the minute organisms so abundant in sea water, to multiply prodigiously, and in turn form a basic food supply for a great variety of larger fishes.

To do this and at the same time contribute something to the forces of evolution, their numbers must be conserved, however. Their silvery sides render them difficult of observation by hungry eyes below, and they are available only to the quick and the keen.

ENORMOUS QUANTITY AND DIVERSITY OF LIFE IN THE GULF STREAM

Over the heat equator warm air is constantly rising. Heavier cooler air from higher latitudes flows steadily in to take its place, and, deflected by the earth's rotation, becomes the easterly trade winds, before which millions of waves, reflecting the clear deep blue of the ocean depths under their white crests, go dancing to the westward.

The whole surface of the tropical Atlantic moves, drifting toward the coast of America, is caught and turned about in the Gulf of Mexico, and shoots out past the Keys and the east coast of Florida as the Gulf Stream.

Inasmuch as many young marine fishes and other animals regularly drift in ocean currents, it is easy to understand what an enormous quantity and diversity of life the Gulf Stream must carry.

Furthermore, such waters, when they enter the Gulf, have already flowed under a tropical sun for many, many miles. The Gulf of Mexico is not a place for them to lose calories, and Gulf Stream water has a considerably higher temperature than the 79 degrees found, in general, at the surface of the open ocean on the Equator.

TRULY TROPICAL FISHES IN FLORIDA WATERS

It follows that shores bathed by such water have as truly tropical fishes as if they were situated much farther south.

Essentially the same fishes extend from Florida to Brazil. Scattered representatives of this great tropical fish fauna of the western Atlantic are drifted to the capes of the Carolinas and, to a less extent, in summer, even to New England. We have seen a stray Spade Fish (*Chaetodipterus faber*) (Plate II) on the New Jersey coast and a little Butterfly Fish (*Chaetodon ocellatus*) (Plate III) washed ashore on the south side of Long Island, New York.

It is a little over ten years ago that the writer made a first trip to Florida. After a prolonged period of more or less distasteful, though necessary, indoor activities during a northern winter, he found himself suddenly foot-loose on the Miami water-front.

The yachting party that he was to join here on a collecting trip among the Keys was somewhere up the coast, stuck on a sand-bank. Meanwhile, there was nothing to do but sit and swing one's heels.



Photograph by John Oliver La Gorce

THE ETERNAL STRUGGLE BENEATH THE SEA

A school of giant tuna fish feeding on myriads of sardines. The tuna were evidently blood-mad and the white patches of water were occasioned by their great bodies breaking above the surface as they hurled themselves among their prey. This is a graphic illustration of the never-ending struggle beneath the wave where the big ones eat the small ones, and only the fittest survive. It is also an evidence of Nature's safeguard against overproduction of species. The swiftly striking tuna charging with wide-open mouth causes the little sardine to jump for his silvery life, but, alas, the instant he shows as much as a fin above the surface low-swinging gulls, attracted from miles around by the disturbed waters, seize him from above. This picture was taken in mid-Gulf Stream and the area covered by the huge school of sardines was several acres.

The first objects of interest were the brown pelicans flapping by. Why they did not break their necks on the bottom when they dove precipitously from a height into water not more than two or three inches deep, was something of a problem.

FISH THAT WEAR VIVID REDS, GREENS,
YELLOW, AND BLUES

But the pelicans were not alone in their ability to see fish. It was soon discovered that a number of interesting species could be observed swimming along the shore. None were more beautiful or as easily identified as the little schools of Pork Fish (Plate I), with their bright yellow markings set off by the bold black pattern on head and shoulders. This fish scarcely belongs with the true, gaudy reef fishes, but rather with those less dependent on the protection of the reef, the golds and blues and rose colors of whose livery are often extremely beautiful, yet seldom striking enough to make the fish conspicuous in the water.

By no means all fishes whose haunts are on and among tropical reefs are brightly colored, but there are a great number of active species found there which wear vivid red, green, yellow, blue, orange, etc., and which, furthermore, are marked in the boldest patterns, frequently with black.

Good examples are the Rock Beauty and the Blue Angel-fish (Plate II). Various parrot-fishes, butterfly-fishes, etc., belong to this class.

Naturalists have offered in explanation that the reef itself was as full of color as a garden of varied flowers, wherein the very brightness of the fishes rendered them inconspicuous. To most observers, however, a coral reef as a whole appears rather monotonous in tone, the many varied fishes swimming about giving it the principal note of high color, and these not only easily seen but readily identified.

SOME FISH CAN AFFORD TO BE CON-
SPICUOUS

How many northern fishes can one see and recognize as easily, swimming in the water, as the black and yellow Sergeant Major (Plate VIII), for instance?

Granted that, in general, these colors render the fish conspicuous, can they be classed as warning colors, like the black-and-yellow striping of wasps? Apparently not, for there are plenty of predaceous fish which eat some of them and would doubtless be pleased to consume more.

Immunity colors, they have been called most appropriately. The idea is that a wide-awake, active fish on a coral reef has so many avenues of escape from its enemies, so many projections to dodge behind and holes to hide in, as to be practically immune from attack. It can afford to be as conspicuous as it likes.

Be this as it may, the striking patterns are a great convenience to the ichthyologist, who has to separate one species from another, for nowhere else does one find so many different, but closely related, species living side by side, each doubtless differing from the others in habits in some way, be it ever so slightly.

THE NUMEROUS FAMILY OF SEA BASSES

One of the principal families of fishes in our southern fauna is the sea basses, to which the gigantic Jewfish, the rock-fishes, groupers, hinds, and so forth, belong. These are all fishes which resemble our northern Sea Bass. They are big-mouthed and voracious species, living for the most part about rocky or uneven bottom, though also swimming out over open stretches of sand.

Many are food-fishes of importance. They have leathery mouths, so that when once hooked they are not easily lost. Though well formed and by no means sluggish, they are solitary and sedentary, as contrasted with the equally abundant predaceous family of snappers, for instance.

Always lurking on the lookout for smaller fishes to come within striking distance, and sometimes associated in considerable numbers at favorable localities, they do not range about, hunting in schools, like the snappers.

The colors of this group are varied and sometimes extremely beautiful, in none more so than in the small Rock Hind (Plate VI), whose home is in the bright lights of the coral reef. But the plan of coloring is such as to lower, not raise, the



Photograph by Herbert R. Duckwald

KILLER WHALE, THE GREAT WOLF OF THE SEA

The ferocity of the "killers" strikes terror to the other warm-blooded animals of the deep. They are known to swallow small seals, and porpoises entire, and they attack large whales by tearing away their lips and tongues. When attacking large prey they work in packs. This specimen was captured in the Gulf Stream between Miami and the Bahama Islands.



Photograph from Walter A. RuKeyser

MIAMI BEACH AT EBB TIDE

Now and then "on-shore" winds bring strange sea visitors to this beautiful beach from the far-flung reaches of the Gulf Stream. However, a change of wind and tide once again sweeps the sands as clear as a ball-room floor. The near-by aquarium frequently profits by unusual specimens that are brought to shore in the sargasso weed and other forms of sea flora, which afford a hiding place for minute fish of many kinds.



Photograph by Thomas Roarty Shipp

MIAMI AQUARIUM BUILDINGS VIEWED FROM THE SOUTH

The Aquarium is situated at the very terminus of the splendid causeway which spans the iridescent waters of Biscayne Bay, connecting the city of Miami with the ocean beach (see pages 53 to 60).

visibility of the fish. Contrast, for instance, the color plans of the Rock Hind and the bizarre Rock Beauty (Plate II).

CHAMELEONS AMONG THE FISHES

These groupers, rock fishes, and hinds, furthermore, have the power of undergoing complete color changes almost instantaneously. The color tone becomes lighter or darker and the markings become bold or fade and disappear. Such color changes can be seen to advantage in individuals kept in an aquarium. There can be no doubt that in the fishes' natural environment they adapt it to the bottom it is swimming over, and, further, that inconspicuousness may aid in its getting a full meal at the expense of its smaller associates.

There is a related fish which has a color pattern almost exactly like that of the Rock Hind, namely, the Spotted Hind. The principal technical difference between the two is that one has minute scales on its maxillary and the other has not—a characteristic about as obvious to the layman as what the fish is thinking about. The Spotted Hind's squarish tail fin, with a broad, blackish border, affords an amateurish, but simpler, way of telling it.

The fish life of warm shores is one of contrasts. In contrast to the big-mouthed sea basses, there are species, usually slug-gish, which have very small mouths, depending for their subsistence on the great abundance of small sea animals found about tropical reefs and ledges, or seaweeds. To capture such small creatures does not require great agility.

THE MALE SEA-HORSE HAS AN INCUBATOR POUCH

The sort of life they lead has probably been taken up gradually, through long periods of time, and many of them have meanwhile acquired remarkable and sometimes quite unfishlike characters of form and structure. None is stranger than the little Sea-horses (Plate IV), with body encased in rings of bony mail, horse-shaped head set at right angles, and prehensile tail to grasp the seaweed where they are hiding, body floating upward erect in the water.

The male sea-horse carries the eggs in a pouch situated under his tail, until they are hatched and the young large enough to fend for themselves.

Sluggish small-mouthed species frequently have hard nipper-like teeth, as the small animals which they eat are many of them shelly.

As it is difficult for them to get out of the way of larger predaceous fish, they are variously protected against attack, mostly being colored more or less in resemblance to their surroundings. The trigger-fishes have a stout dorsal spine which locks erect, as well as a very thick leathery hide which must be of some protection. The gaudy colors of the Queen Trigger-fish (Plate V) are an exception among such forms.

A somewhat related flat-sided filefish scarcely swims about at all, but drifts with the tides, more or less head downward, and can be easily captured in the hand. It is so striped as to be readily overlooked, however, among the eel-grass which is drifting with it.

HOW THE SWELL-FISH FRIGHTENS ITS ENEMIES

The swell-fishes have the power of suddenly inflating the body with water or air until they assume an approximately globular form several times the normal diameter, which must be disconcerting to any enemy about to seize one. The porcupine-fish, in addition to doing this, has the body everywhere covered with long, sharp spines which project in every direction like the quills of a hedgehog. Many persons who are familiar with the inflated skins of swell-fishes and porcupine-fish used by the Japanese as picturesque lanterns will be surprised to learn that both are common in local waters.

The trunk-fishes, instead of being protected in this way, have the body encased in a bony shell, like a turtle. In the East Indies there are rectangular species, but ours are all three-cornered, beechnut-shaped. They go by various names—cuckold, shellfish, and so forth, the Cowfish (Plate V) being a species with two hornlike spines projecting from its forehead. They are excellent eating, cooked in the shell like a lobster.

The back muscles of the swell-fishes are sometimes eaten, but make a risky

delicacy, as there are well authenticated instances of severe poisoning from eating these fishes. The poison seems to be localized in the viscera and to permeate the rest of the fish after death.

SOME FISH ARE RISKY DELICACIES

In some quarters of Japan swell-fish is highly esteemed when prepared for the table with care, but there is a Japanese proverb to the effect that before eating swell-fish one should have one's last will and testament in good order.

Poisoning resultant from eating certain species of tropical fishes is a subject which will repay further study. In Cuba several kinds are reputed dangerous and their sale prohibited in the larger markets. Among them are the Great Barracuda (see illustration, page 80), Green Moray (Plate III), and certain species of the Carangiidae, or crevally family. On the other hand, this same Barracuda is particularly favored as a food-fish in Porto Rico, as it is known to subsist entirely on clean, live food.

It is said in Cuba that by no means all the fishes of these species are poisonous, and that the smaller ones are safer. The symptoms of poison are sometimes alimentary disorders, sometimes skin troubles. The cause is not known, but Mowbray, writing in the New York Zoölogical Society Bulletin, November, 1916, presents a strong case in favor of the hypothesis that such tropical fish poisoning is in most cases due to improper marketing. He says: "It is probable that if, when caught, the fish were eviscerated and bled, a case of poisoning would be a rarity."

Bulletin No. I of the Madras (India) Fisheries Bureau, 1915, thus emphasizes the importance of properly marketing fish in a tropical climate: "Of all general food, fish is most liable to taint and most poisonous when tainted. . . . Fish not kept alive *must be cleaned and washed at sea* and properly stowed. This brings them to shore with a much decreased chance of taint, even if several hours intervene."

SNAPPERS ARE THE MOST IMPORTANT SOUTHERN FOOD-FISH

As food-fishes, the snappers are perhaps the most important southern family.



Photograph by L. L. Mowbray

THE WHITE ARMED ANEMONE

Sea-anemones, closely resembling beautiful and many-hued chrysanthemums, are found among the rocks in quiet waters along the Gulf shores. This low form of animal life feeds by arresting with its outspread petal-like tentacles small particles of food floating by, which it then draws toward the central mouth. From a muscular base the anemone can move very slowly from place to place, one observation in the New York Aquarium showing a travel of forty-eight inches in the course of twenty-four hours. They have no food value for man, but are sometimes eaten by fish.

A snapper is an all-around, up-to-date fish, an evolutionary product of the keenest of all competition in the fish world, that at the tropical shore-line.

There is nothing peculiar or freakish about the snapper. He is just thoroughly successful and modern, active, adaptable, and clever—trim-formed, spiny-finned, keen-eyed, smooth-scaled, and strong-toothed.

Almost anywhere one goes one can see little schools of the Gray Snapper through the clear tropical water, skirting the

shore or the edge of the mangroves, on the lookout for small fry to satisfy their appetites, and at the same time with a weather eye out for possible danger. It would seem a simple matter to catch one on hook and line, but no fish is wariest about being thus ensnared.

Several species of snappers are almost equally abundant, the Muttonfish and the Red Snapper, which is taken in comparatively deep water, being perhaps the most important commercially.

The excellence of the Red Snapper is



Undersea Photograph by Dr. W. H. Longley

PORTRAIT TAKEN BENEATH THE SURFACE OF THE SOUTH ATLANTIC

Porkfishes and tang against a background of live coral six feet or more under water among the Florida Keys. The shadowy object, suggesting an irritated porcupine, near the lower right corner, is a purple sea-urchin with spines erect.

widely known, and quantities of this fish are shipped to distant northern markets. For baking, a fine large one has few equals. Bright red color in fishes has often a peculiar significance, which will be spoken of later.

Though not exactly a snapper, the excellent table-fish known as the Yellow Tail (Plate VII) belongs to the snapper family. It is somewhat more elongated than the true snappers, with lines more graceful, and its tail-fin is more deeply forked. One sees immediately that it is a freer, swifter swimmer, navigating wider stretches of more open water.

WHY SWIFT SWIMMING FISH HAVE FORKED TAILS

Most marine animals which swim, especially swiftly and continuously, have a forked tail-fin. This shape of tail avoids the space immediately behind the axis of the body where the stream-lines

following the sides (of a moving fish) converge. A rounded or pointed tail which would occupy such area would be a drag.

Whales and porpoises, though they move the tail up and down instead of from side to side, have a forked tail-fin, only it lies in a horizontal instead of a vertical plane. The wide ranging members of the mackerel family and other more or less related marine fishes have a forked tail-fin set on a firm, narrow base; and the freest swimming sharks (mackerel sharks and the Man-eater) have acquired a tail of the same shape, though the ordinary shark tail is weak and unsymmetrical.

Fresh-water minnows almost invariably have a forked tail-fin, waters which they have to traverse being considerable in relation to the small size of the fishes themselves.

In the blues and greens of the waters



Photograph by Dr. W. H. Longley

PANIC UNDERSEAS

This wonderful photograph was taken, not in an aquarium tank, but about eight feet under water in the Gulf Stream, with an especially designed camera. Posing for their portraits are gray snappers, yellow goatfish, grunts, a parrot-fish, and a schoolmaster, nocturnal fish, which, as a rule, rest quietly all day. The seeming confusion is due, however, to the presence in their neighborhood of a barracuda, that veritable tiger of the warm seas and the natural enemy of all small fish.

through which it swims, the Yellow Tail's bright yellow tail probably makes a shining mark, though its colors otherwise are well calculated to give it a low visibility. Are we to conclude from this that there are no larger fishes which prey on it? No; there pretty surely are such fishes, though it may well be so swift as to escape many which would otherwise do so.

DEEP SWIMMING FISH ARE OFTEN RED IN COLOR

As regards concealment, having a yellow tail must be a disadvantage to it, and is a character which would doubtless have been lost in the keen competition of the tropical waters where it lives, were there not, on the other hand, some compensating advantage. It may be a badge of identification, useful to a school in keeping together.

It has been previously mentioned that the Red Snapper comes from deeper water than other common snappers. There is a tendency for fishes which swim deep down under the blue or green sea and yet within the range of surface light penetration to be red in color. A great many are not, to be sure, but a larger proportion are red here than elsewhere, frequently a clear bright striking red all over.

It seems almost a pity that the light in which they live is so green that the color, red, must appear an intangible neutral gray! Perhaps it gives them a useful inconspicuousness down there, or perhaps it absorbs a maximum amount of the dim, strongly blue-green sunlight, which is in some way beneficial.

One of the commonest species of the surface reefs, the Squirrel Fish (Plate I),



Photograph by James A. Allison

MIAMI AQUARIUM COLLECTING CRUISER "L'APACHE"

L'Apache, Captain C. W. Peterson commanding, is one of a fleet of three power cruisers used for investigating fish habitat in southern Florida waters and among the Bahama Islands. The *Allisoni* and *Chub*, sister ships, were built for the purpose of gathering and bringing in live specimens in their especially constructed live wells (see pages 53 to 60).

has a regular, bright, "deep-water" red color. But the mystery of how it comes to such a color is easily explained, for it has similar relatives living deeper down. Evidently the Squirrel Fish has recently come up in the fish world, and its big eyes indicate that it has not yet adjusted itself to the bright light of the surface sun, but is more or less nocturnal.

The Gulf Stream runs so close to the coast of Florida that, when the wind is right, quantities of the drifting yellow gulf-weed it carries are washed ashore and into the bays. A variety of fishes hide in and about this weed.

One of the commonest and perhaps the most interesting, namely, the Mouse Fish, spends its entire life in the drifting sargassum. Colored in wonderful mimicry of this habitat, its shape also, grotesquely irregular, covered with leaf-like processes or flakes, heightens the resemblance, so as to make it well nigh invisible. This protection against larger fish which might disturb it probably also serves the purpose of camouflage to enable it to approach and capture smaller fish, crabs, and shrimps.

The Mouse Fish, for its size, has a

large mouth and appetite in proportion. Many other species hide in the weed when young and, as a rule, have colors to match at that time of life, though later these may be quite different.

THE PORTUGUESE MAN-OF-WAR HAS A FAITHFUL COMPANION FISH

The rainbow-tinted pink, blue, or purple bubble-like floats of the Portuguese Man-of-war (Plate IV) drift at the surface over all tropical oceans and are sometimes washed in close to the shore in numbers. With them comes an interesting little fish, *Nomeus*, the sting of which is exceedingly severe, which never strays far from the tentacles which stream below the Man-of-war.

When traveling by steamer along the Florida coast the writer has watched for *Nomeus*, and from where he stood on deck has seen one and sometimes more individuals lying suspended in the clear water, their blackish ventral fins conspicuously spread, always within a short distance of a Man-of-war, floating above.

Comparatively few kinds of fishes are abundant "off-sounding," away from the influence of the shore-line, and these may



Photograph by John Oliver La Gorce

THE SEA TIGER—A BARRACUDA

Because of the clarity of the waters of the Gulf Stream and with the ever-occurring carpet of white sand on the bottom to be found along Floridian shores, this unusual photograph of a five-foot barracuda was obtained by simply holding a kodak over the side of the boat and snapping the big fish swimming along six feet or more below the surface. Because of the splendid illumination afforded by the sun on the white sand, even the shadow of the fish, as well as the little tufts of sea flora, was recorded.

be divided rather sharply into the hunters and the hunted. Mouse Fish and *Nomeus*, belonging to the latter class—the one hides, the other lives under the protection of a powerful companion.

WHEN THE FLYING-FISHES PLAY

Flying-fishes, which are abundant, have an even more interesting method of escaping their enemies, leaping above the surface and, with favorable wind conditions, shooting through the air for perhaps as much as an eighth of a mile, supported by their long, stiff breast-fins, widely spread at right angles to the body. When there is a whole-sail breeze blowing, they seem to fly also for sport.

A flock of little flying-fishes no bigger than herring, all in the air at once, gleaming blue and white silver in the sun, is one of the most beautiful sights of a tropical sea. The very thought of it takes one back to the broad blue expanse of trade-wind ocean, warm decks lurching under foot, spray singing through the shrouds, squawking tropic birds and bellying square-sails which swing against a background of fleecy cloud and sky.

In spite of their agility, flying-fishes form the chief food of the little schools of Oceanic Bonitos, and of the Dolphins, swiftest, most graceful, and most highly colored of marine fishes, which prowl over the high seas.

THE PRIMEVAL SHARK IS STILL WITH US

Agas before modern fishes, of which we now find such countless variety in tropical seas, had been evolved in the slow process of evolution, there were sharks which differed comparatively little from those of the present day. Intermediate forms have become antiquated and dropped out, but the primeval shark (Plate VI) is still with us. Especially in the tropics they occur in great abundance.

Prowling singly along the edges of the reefs, over the shallow flats, or through offshore stretches of open water, they hunt largely by sense of smell, and congregate in numbers wherever food is abundant.

When a whale is being cut up at sea it is astonishing how quickly the slender

offshore Blue Sharks gather to the feast; it would almost seem from nowhere.

By far the most abundant sharks numerically are the ground sharks (*Carcharhinus*). There is probably no tropical or temperate coast-line where one or more species of this genus do not enter the bays and inshore water at the proper season to give birth to their young.

SHARKS PROPAGATE UNLIKE MOST OTHER FISHES

Though relics of a bygone age, as far as bodily structure is concerned, sharks, of all fishes, have the most highly developed reproductive system. Some lay a few large eggs, each one protected by a horny shell, but for the most part the egg stage is passed through within the body of the parent fish, and the young are born well grown and able to fend for themselves.

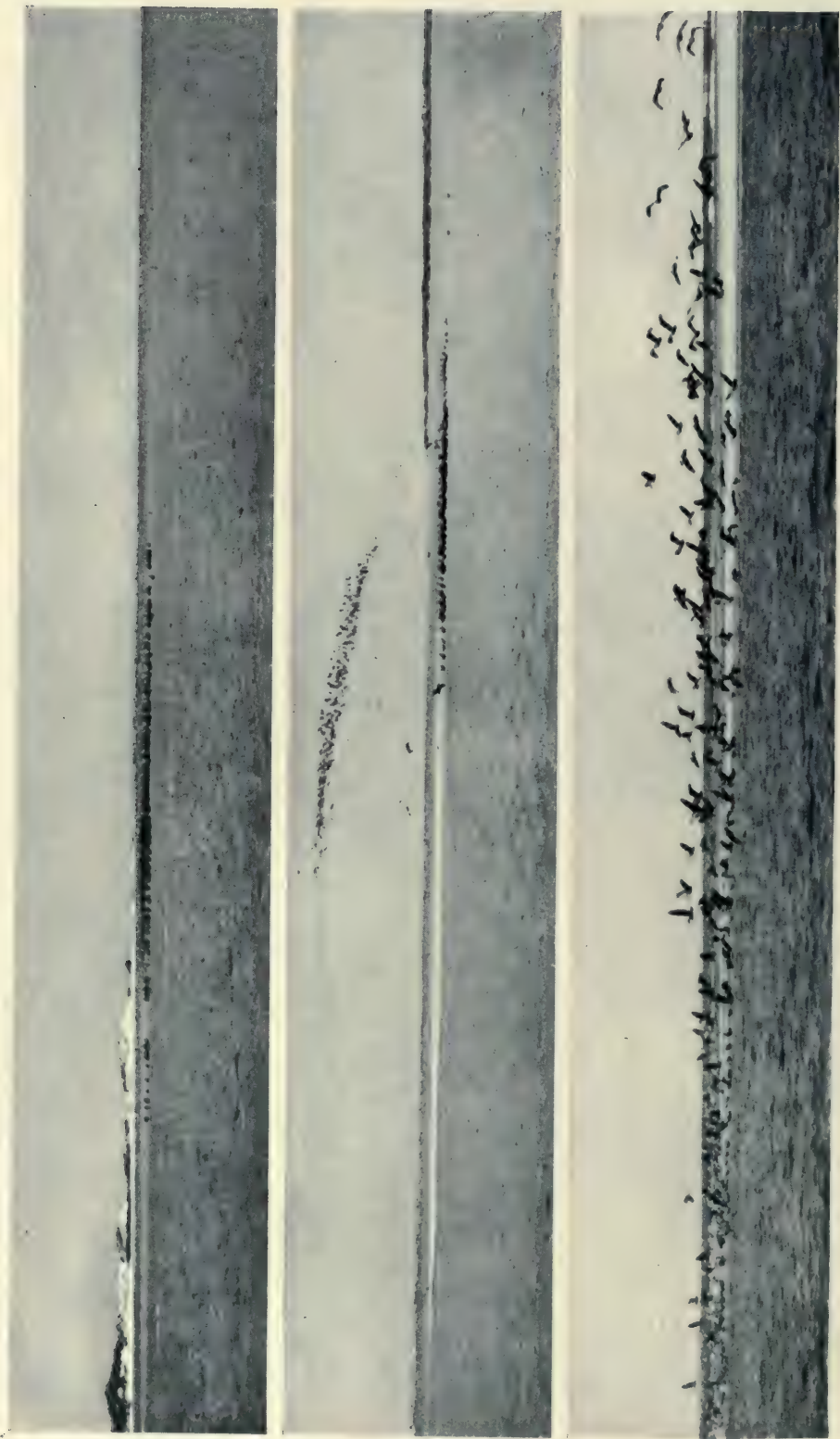
The Black-tip Shark (*Carcharhinus limbatus*) is a small species of ground shark, females of which are taken with young in the Bay of Florida in April. They are frequently hooked by tarpon fishermen, who erroneously call them "mackerel shark," and put up a spirited fight when so hooked. They are usually between five and five and a half feet in length, and the young, about three to six in number, are two feet long, or a little less, when born.

We have data concerning another ground shark, *Carcharhinus milberti*, the Brown Shark, which gives birth to its young in Great South Bay, New York, in midsummer. The mother sharks are a little larger—six or seven feet—the young, however, of about the same size, but more of them, eight to eleven having been recorded for this species. Some kinds of sharks which grow much larger have a proportionately larger number of young.

While evolution has been molding other more modern fishes into a great variety of forms to fit every niche in the infinitely varied but unchanging environment of tropical seas, the shark has always been much as we find him today.

A FISH THAT UTILIZES A SHARK AS A TAXI

It is not surprising, therefore, that there is a fish which owes its very re-



Photograph by John Oliver La Gorce

PELICAN FISHERMEN RESTING BETWEEN TIDES: MOSQUITO INLET, FLORIDA

A dignified policeman-like bird is the pelican as he sails along with a wingspread of seven or eight feet. All dignity is cast aside, however, when his keen eye sights a fish, for he flops down from a considerable height and strikes the water with a crash and splash that should by all natural laws break every bone in his body, yet apparently never disturbs him. Recent investigations by the Biological Survey prove that instead of a wholesale consumer of valuable food fish, the pelican of our South Atlantic coast lives almost entirely on menhaden, a fish of comparatively little value.

markable structure and habits to the presence of sharks. This is the slender Shark Sucker (Plate VI), which has the anterior portion of its body horizontally flattened, and a remarkable oval structure, with movable slats like those of a blind, on the top of its head. With this apparatus it attaches itself firmly at will to the shark's broad side and thus as a "dead head" passenger is transported through long stretches of ocean without any effort on its own part.

The Shark Sucker is boldly and very beautifully striped with black and white, but can change its color almost instantly to a dull, uniform gray matching the side of the shark to which it is clinging. It sometimes attaches itself also to other large fishes, such as the Tarpon, or to turtles.

A related species, the true Remora, is found clinging to those sharks which swim through the high seas far from shore. A third is found clinging about the gills of spearfish or marlin swordfish, as they are called by California anglers. A fourth, with very large and strong sucking disk, has been found attached to whales.

All of these may, loosely speaking, be called Remoras. They are sometimes erroneously spoken of as "Pilot-fish," for the Pilot-fish is an entirely different small species related to the Amber Jack, which swims in front of or alongside of sea-going sharks and is vertically banded with black.

THE REMORAS ARE ONE OF OCEAN'S MYSTERIES

Among the fishes of the world the Remoras occupy the position of a genius with unknown ancestry. There is nothing else like them, and to what manner of fishes they may be related is one of the mysteries of old ocean.

Fish life of the shallow pools so often found along a rocky shore at low tide will repay careful study. Such a pool may be a few yards long, with a very irregular outline, full of nooks and crannies, and a few square feet of sand covering its lowest point.

Here the young of several types of fishes act out in miniature the drama which their elders are playing on the

reef. Only the villains of the play, the larger predaceous fishes, are absent, at least for the present, until the returning flood inundates the isolated pool to make it once more a part of the big salt water, and we retreat up the beach.

The stage setting is extremely simple: the jagged blackish bottom of the pool, small area of gray-white sand, a little patch of brownish seaweed in one place, either growing there or drifted in at the last high water. From a distance half a dozen small fishes are visible, swimming actively about.

Nearer view shows them to consist of two or three Sergeant Majors (Plate VIII), instantly recognized by the black and yellow uniform in vertical stripes; a couple of Beau Gregorys, with bright blue heads and yellow tails separated by a slanting line of demarcation, and a young Wrasse striped lengthwise with black on a pale ground.

THE WRASSE CHANGES ITS COLOR INSTANTLY

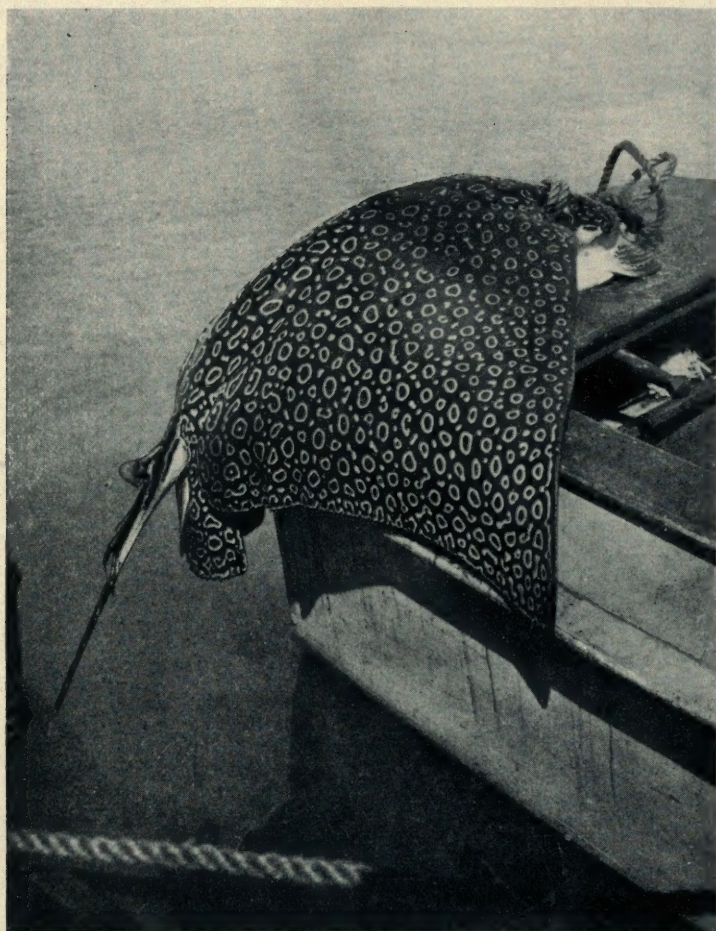
If one attempt to catch a fish of either of the former species, it displays great alertness and agility, dodging about the many projections and irregularities of rock. But now we have the Wrasse cornered and believe we have it in an instant, when suddenly it has disappeared.

Surely it did not dodge past and make good its escape in that way. Where can it be? Two or three minutes of careful scrutiny are rewarded. There it is, motionless, squeezed into a crevice of the side of the pool just large enough to hold it.

Swimming actively about, it was scarcely less conspicuous than the Sergeant Majors, but it has now, furthermore, changed color, so as to have a very low visibility in its sheltered nook. Here we have an illustration in detail of how various theoretical types of coloring work out. While swimming about with them the Wrasse had a conspicuous *immunity* pattern like the Sergeant Majors; now, in the twinkling of an eye, it is a concealingly colored fish.

THE SAND FLOUNDER DEFIES DETECTION

We have been speaking of fishes which no one will hesitate to admit are conceal-



Photograph by John Oliver La Gorce

PROMINENT MEMBER OF THE NUMEROUS RAY FAMILY

The whip ray, or spotted sting ray, as he is also known, is now and then seen in the shallow waters adjacent to Miami. The ray uses its broad cephalic fins much as a bird its wings and seems to fly rather than swim through the water. It is beautifully marked with many golden-brown rings. It is not edible.

ingly colored; but, lying in plain view on the sand, there is a little pale-colored Sand Flounder so exceedingly inconspicuous that it is unlikely that we shall see it unless the water is drawn out of the pool and its inhabitants raked into our collecting bottles.

Even now the possibilities of such a pool have not been exhausted.

NOISY FISHES OF THE DEEP

One thinks of fishes as leading a life of perpetual silence down there under the waters. This generalization is not in all cases true, however. Lying anchored in a small boat at night in

Florida waters, one may sometimes hear a school of sea-drum go swimming by below. "Wop, wop, wop," they seem to say. Then there is the little Trumpet-fish, so called, whose identity is open to question, technically speaking, that will at times lurk under the boat and intrigue you with its elfin tooting.

Many species utter croaking or grunting sounds when caught, the various species of grunts owing their name to this habit.

Grunts are fish somewhat resembling snappers in appearance and to a certain extent in habit, but smaller and less vigorous. They are variously and artistically colored in grays, blues, and yellows. The Blue-striped or Yellow Grunt (Plate VII) is yellow, with blue length-wise stripes. The Common Grunt has many narrow stripes of deep, clear blue on the head, the scales of the shoulder region enlarged and conspicuous,

bronze in color, with grayish borders. The French Grunt is light bluish gray, with broad, undulating, irregular stripes of yellow; and there are many other varieties.

Grunts have bright red or orange color at the base of the jaws and inside the large mouth. The color is not visible when the mouth is closed.

So wonderful and varied are the fishes of our warm seas that one could write on and on about them did time permit; however, in a later issue of THE GEOGRAPHIC will appear another and more extensive color series of the brilliant fish of the Gulf Stream.

